

Low Capacitance, Low Charge Injection, $\pm 15 \text{ V}/12 \text{ V } i \text{CMOS SPDT in SOT-23}$

ADG1219

FEATURES

<0.5 pC charge injection over full signal range 2.5 pF off capacitance Low leakage; 0.6 nA maximum @ 85°C 120 Ω on resistance Fully specified at +12 V, \pm 15 V No V_L supply required 3 V logic-compatible inputs Rail-to-rail operation 8-lead SOT-23 package

APPLICATIONS

Automatic test equipment Data acquisition systems Battery-powered systems Sample-and-hold systems Audio/video signal routing Communication systems

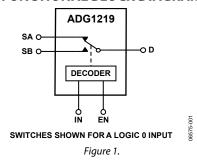
GENERAL DESCRIPTION

The ADG1219 is a monolithic *i*CMOS® device containing an SPDT switch. An EN input is used to enable or disable the device. When disabled, all channels are switched off. When on, each channel conducts equally well in both directions and has an input signal range that extends to the supplies. Each switch exhibits break-before-make switching action.

The *i*CMOS (industrial CMOS) modular manufacturing process combines high voltage complementary metal-oxide semiconductor (CMOS) and bipolar technologies. It enables the development of a wide range of high performance analog ICs capable of 33 V operation in a footprint that no other generation of high voltage parts has been able to achieve. Unlike analog ICs using conventional CMOS processes, *i*CMOS components can tolerate high supply voltages while providing increased performance, dramatically lower power consumption, and reduced package size.

The ultralow capacitance and exceptionally low charge injection of these multiplexers make them ideal solutions for data acquisition and sample-and-hold applications, where low glitch and fast settling are required. Figure 2 shows that there is minimum

FUNCTIONAL BLOCK DIAGRAM



charge injection over the entire signal range of the device. iCMOS construction also ensures ultralow power dissipation, making the parts ideally suited for portable and battery-powered instruments.

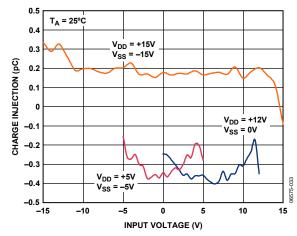


Figure 2. Charge Injection vs. Input Voltage

ADG1219* PRODUCT PAGE QUICK LINKS

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COMPARABLE PARTS 🖵

View a parametric search of comparable parts.

DOCUMENTATION

Application Notes

 AN-874: Operating the ADG12xx Series of Parts with 5 V Supplies and the Impact on Performance

Data Sheet

 ADG1219: Low Capacitance, Low Charge Injection, ±15 V/ 12 V iCMOS SPDT in SOT-23 Data Sheet

REFERENCE MATERIALS 🖵

Product Selection Guide

• Switches and Multiplexers Product Selection Guide

DESIGN RESOURCES 🖵

- · ADG1219 Material Declaration
- PCN-PDN Information
- · Quality And Reliability
- Symbols and Footprints

DISCUSSIONS •

View all ADG1219 EngineerZone Discussions.

SAMPLE AND BUY 🖵

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REVISION HISTORY

3/09—Rev. 0 to Rev. A

Change to Power Requirements, IDD Parameter, Table 1	4
Change to Power Requirements, IDD Parameter, Table 2	5
Updated Outline Dimensions1	5

4/08—Revision 0: Initial Version

SPECIFICATIONS

DUAL SUPPLY

 V_{DD} = 15 V \pm 10%, V_{SS} = –15 V \pm 10%, GND = 0 V, unless otherwise noted.

Table 1.

B Version ¹						
Parameters	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments	
ANALOG SWITCH						
Analog Signal Range			V_{DD} to V_{SS}	V		
On Resistance, Ron	120			Ω typ	$V_s = \pm 10 \text{ V}, I_s = -1 \text{ mA}$; see Figure 23	
	200	240	270	Ω max	$V_{DD} = +13.5 \text{ V}, V_{SS} = -13.5 \text{ V}$	
On Resistance Match Between Channels, ΔR_{ON}	3.5			Ωtyp	$V_S = \pm 10 \text{ V}, I_S = -1 \text{ mA}$	
	6	10	12	Ω max		
On Resistance Flatness, R _{FLAT(ON)}	20			Ω typ	$V_s = -5 \text{ V}, 0 \text{ V}, +5 \text{ V}; I_s = -1 \text{ mA}$	
	64	76	84	Ω max		
LEAKAGE CURRENTS					$V_{DD} = +16.5 \text{ V}, V_{SS} = -16.5 \text{ V}$	
Source Off Leakage, I _s (Off)	±0.004			nA typ	$V_s = \pm 10 \text{ V}, V_s = \pm 10 \text{ V}; \text{ see Figure 24}$	
	±0.1	±0.6	±1	nA max		
Drain Off Leakage, I _D (Off)	±0.009			nA typ	$V_S = \pm 10 \text{ V}, V_S = \pm 10 \text{ V}; \text{ see Figure 24}$	
	±0.1	±0.6	±1	nA max		
Channel On Leakage, ID, Is (On)	±0.02			nA typ	$V_S = V_D = \pm 10 \text{ V}$; see Figure 25	
	±0.2	±0.6	±1	nA max		
DIGITAL INPUTS						
Input High Voltage, V _{INH}			2.0	V min		
Input Low Voltage, VINL			0.8	V max		
Input Current, I _{INL} or I _{INH}	0.005			μA typ	$V_{IN} = V_{INL}$ or V_{INH}	
•			±0.1	μA max		
Digital Input Capacitance, C _{IN}	2			pF typ		
DYNAMIC CHARACTERISTICS ²						
Transition Time, trransition	140			ns typ	$R_L = 300 \Omega, C_L = 35 pF$	
	170	200	230	ns max	$V_s = 10 \text{ V}$; see Figure 30	
t _{on} (EN)	85			ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$	
	105	130	140	ns max	$V_s = 10 \text{ V}$; see Figure 30	
t _{OFF} (EN)	105			ns typ	$R_L = 300 \Omega, C_L = 35 pF$	
	125	150	170	ns max	$V_s = 10 \text{ V}$; see Figure 30	
Break-Before-Make Time Delay, tbbm	40			ns typ	$R_L = 300 \Omega, C_L = 35 pF$	
·			10	ns min	$V_{S1} = V_{S2} = 10 \text{ V}$; see Figure 31	
Charge Injection	0.1			pC typ	$V_S = 0 \text{ V}, R_S = 0 \Omega, C_L = 1 \text{ nF};$ see Figure 32	
Off Isolation	77			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 1 MHz$; see Figure 26	
Channel-to-Channel Crosstalk	80			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 1 MHz$; see Figure 27	
Total Harmonic Distortion + Noise	0.15			% typ	$R_L = 10 \text{ k}\Omega$, 5 V rms, $f = 20 \text{ Hz}$ to 20 kHz	
−3 dB Bandwidth	520			MHz typ	$R_L = 50 \Omega$, $C_L = 5 pF$; see Figure 28	
C _s (Off)	2.5			pF typ	$f = 1 \text{ MHz}; V_S = 0 \text{ V}$	
, ,	3.3			pF max	$f = 1 \text{ MHz}$; $V_S = 0 \text{ V}$	
C _D (Off)	4.3			pF typ	$f = 1 \text{ MHz}; V_S = 0 \text{ V}$	
•	5.1			pF max	$f = 1 \text{ MHz}; V_S = 0 \text{ V}$	
C_D , C_S (On)	7.5			pF typ	$f = 1 \text{ MHz}; V_S = 0 \text{ V}$	
	10			pF max	$f = 1 \text{ MHz}; V_S = 0 \text{ V}$	

		B Version ¹				
Parameters	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments	
POWER REQUIREMENTS					$V_{DD} = +16.5 \text{ V}, V_{SS} = -16.5 \text{ V}$	
I_{DD}	0.001			μA typ	Digital inputs = 0 V or V_{DD}	
			1.0	μA max		
I _{DD}	140			μA typ	Digital inputs = 5 V	
			190	μA max		
I _{SS}	0.001			μA typ	Digital inputs = 0 V , 5 V or V_{DD}	
			1.0	μA max		
V_{DD}/V_{SS}			±5/±16.5	V	$ V_{DD} = V_{SS} $	
				min/max		

SINGLE SUPPLY

 V_{DD} = 12 V ± 10%, V_{SS} = 0 V, GND = 0 V, unless otherwise noted.

Table 2.

		B Versio	n¹		
Parameters	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			$0\ V\ to\ V_{DD}$	V	
On Resistance, Ron	300			Ω typ	$V_s = 0 \text{ V to } 10 \text{ V}, I_s = -1 \text{ mA}; \text{ see Figure } 23$
	475	567	625	Ω max	$V_{DD} = 10.8 \text{ V}, V_{SS} = 0 \text{ V}$
On Resistance Match Between Channels, ΔR_{ON}	4.5			Ωtyp	$V_S = 0 \text{ V to } 10 \text{ V}, I_S = -1 \text{ mA}$
	16	26	27	Ω max	
On Resistance Flatness, R _{FLAT(ON)}	60			Ωtyp	$V_s = 3 \text{ V}, 6 \text{ V}, 9 \text{ V}, I_s = -1 \text{ mA}$
LEAKAGE CURRENTS					V _{DD} = 13.2 V
Source Off Leakage, I₅ (Off)	±0.006			nA typ	$V_S = 1 \text{ V}/10 \text{ V}, V_D = 10 \text{ V}/1 \text{ V}; \text{ see Figure 24}$
	±0.1	±0.6	±1	nA max	
Drain Off Leakage, I _D (Off)	±0.006			nA typ	$V_S = 1 \text{ V}/10 \text{ V}, V_D = 10 \text{ V}/1 \text{ V}; \text{ see Figure 24}$
	±0.1	±0.6	±1	nA max	
Channel On Leakage, ID, IS (On)	±0.02			nA typ	$V_S = V_D = 1 \text{ V or } 10 \text{ V; see Figure } 25$
	±0.2	±0.6	±1	nA max	
DIGITAL INPUTS					
Input High Voltage, V _{INH}			2.0	V min	
Input Low Voltage, V _{INL}			0.8	V max	
Input Current, I _{INL} or I _{INH}	0.001			μA typ	$V_{IN} = V_{INL}$ or V_{INH}
			±0.1	μA max	
Digital Input Capacitance, C _{IN}	3			pF typ	
DYNAMIC CHARACTERISTICS ²					
Transition Time, ttransition	195			ns typ	$R_L = 300 \Omega, C_L = 35 pF$
	250	300	340	ns max	$V_s = 8 \text{ V}$; see Figure 30
t _{on} (EN)	120			ns typ	$R_L = 300 \Omega, C_L = 35 pF$
	150	190	210	ns max	$V_s = 8 \text{ V}$; see Figure 30
toff (EN)	145			ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$
	185	220	255	ns max	$V_s = 8 \text{ V}$; see Figure 30
Break-Before-Make Time Delay, t _{BBM}	70			ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$
			10	ns min	$V_{S1} = V_{S2} = 8 \text{ V}$; see Figure 31
Charge Injection	-0.8			pC typ	$V_s = 6 \text{ V}$, $R_s = 0 \Omega$, $C_L = 1 \text{ nF}$; see Figure 32
Off Isolation	80			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 1 MHz$; see Figure 26
Channel-to-Channel Crosstalk	80			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 1 MHz$; see Figure 27
–3 dB Bandwidth	400			MHz typ	$R_L = 50 \Omega$, $C_L = 5 pF$; see Figure 28

 $^{^1}$ Temperature range for B version is -40°C to $+125^\circ\text{C}.$ 2 Guaranteed by design; not subject to production test.

		B Version	1 ¹		
Parameters	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
C _s (Off)	2.9			pF typ	$f = 1 \text{ MHz; } V_S = 6 \text{ V}$
	3.7			pF max	$f = 1 \text{ MHz; } V_s = 6 \text{ V}$
C _D (Off)	5			pF typ	$f = 1 MHz; V_s = 6 V$
	5.8			pF max	$f = 1 \text{ MHz; } V_S = 6 \text{ V}$
C_D , C_S (On)	8.5			pF typ	$f = 1 \text{ MHz; } V_S = 6 \text{ V}$
	11			pF max	$f = 1 \text{ MHz; } V_s = 6 \text{ V}$
POWER REQUIREMENTS					V _{DD} = 13.2 V
I _{DD}	0.001			μA typ	Digital inputs = 0 V or V _{DD}
			1.0	μA max	
I_{DD}	140			μA typ	Digital inputs = 5 V
			190	μA max	
V_{DD}			5/16.5	V min/max	$V_{SS} = 0 \text{ V, GND} = 0 \text{ V}$

 $^{^1}$ Temperature range for B version is -40°C to $+125^\circ\text{C}.$ 2 Guaranteed by design; not subject to production test.

ABSOLUTE MAXIMUM RATINGS

 $T_A = 25$ °C, unless otherwise noted.

Table 3.

Table 5.	
Parameter	Rating
V _{DD} to V _{SS}	35 V
V _{DD} to GND	−0.3 V to +25 V
V _{SS} to GND	+0.3 V to −25 V
Analog Inputs ¹	$V_{SS} - 0.3 \text{ V to } V_{DD} + 0.3 \text{ V or}$ 30 mA, whichever occurs first
Digital Inputs ¹	$GND - 0.3 V$ to $V_{DD} + 0.3 V$ or 30 mA, whichever occurs first
Peak Current, S or D	100 mA (pulsed at 1 ms, 10% duty cycle maximum)
Continuous Current per Channel, S or D	30 mA
Operating Temperature Range	
Industrial (B Version)	−40°C to +125°C
Storage Temperature Range	−65°C to +150°C
Junction Temperature	150°C
8-Lead SOT-23, θ _{JA} Thermal Impedance	211.5°C/W
Reflow Soldering Peak Temperature, Pb Free	260°C

 $^{^{\}rm 1}$ Overvoltages at IN, S, or D are clamped by internal diodes. Current should be limited to the maximum ratings given.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS



Figure 3. SOT-23 Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	EN	Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the IN logic input determines which switch is turned on.
2	V_{DD}	Most Positive Power Supply Potential.
3	GND	Ground (0 V) Reference.
4	V _{SS}	Most Negative Power Supply Potential.
5	SB	Source Terminal. Can be an input or output.
6	D	Drain Terminal. Can be an input or output.
7	SA	Source Terminal. Can be an input or output.
8	IN	Logic Control Input.

Table 5. Truth Table

EN	IN	Switch A	Switch B
0	Х	Off	Off
1	0	On	Off
1	1	Off	On

TYPICAL PERFORMANCE CHARACTERISTICS

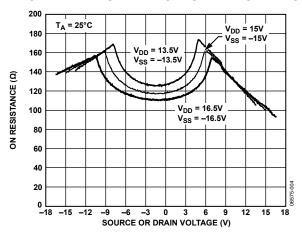


Figure 4. On Resistance as a Function of V_D (V_S) for Dual Supply

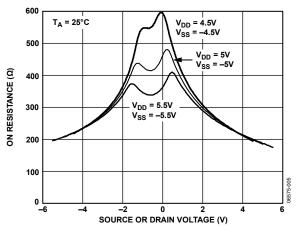


Figure 5. On Resistance as a Function of V_D (V_S) for Dual Supply

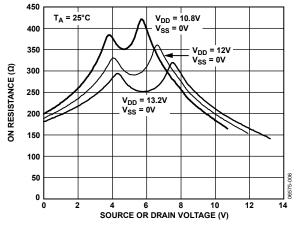


Figure 6. On Resistance as a Function of V_D (V_S) for Single Supply

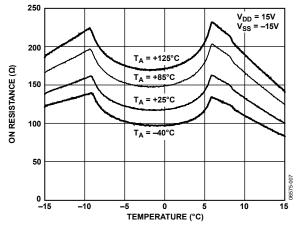


Figure 7. On Resistance as a Function of V_D (V_S) for Different Temperatures, Dual Supply

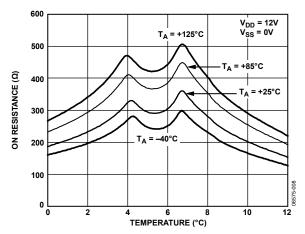


Figure 8. On Resistance as a Function of V_D (V_S) for Different Temperatures, Single Supply

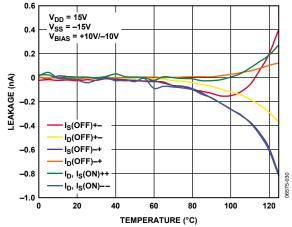


Figure 9. Leakage Currents as a Function of Temperature, 15 V Dual Supply

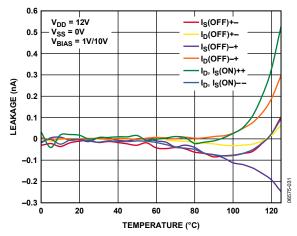


Figure 10. Leakage Currents as a Function of Temperature, 12 V Single Supply

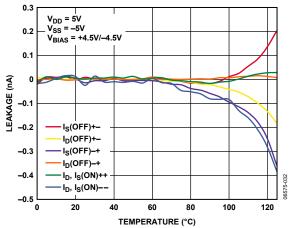
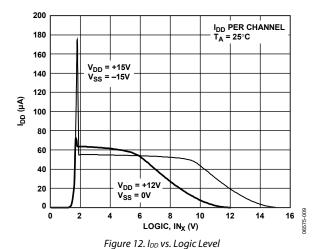


Figure 11. Leakage Currents as a Function of Temperature, 5 V Dual Supply



0.5 T_A = 25°C 0.4 V_{DD} = +15V V_{SS} = -15V 0.3 CHARGE INJECTION (pC) 0.2 0.1 0 V_{DD} = 12V V_{SS} = 0V -0.2 -0.3 V_{DD} = +5V -0.4 V_{SS} = -5V -0.5 └--15 -5 0 10 15 INPUT VOLTAGE (V)

Figure 13. Charge Injection vs. Input Voltage

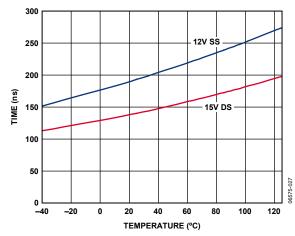


Figure 14. t_{TRANSITION} Time vs. Temperature

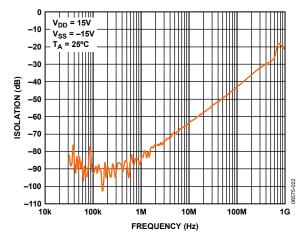


Figure 15. Off Isolation vs. Frequency

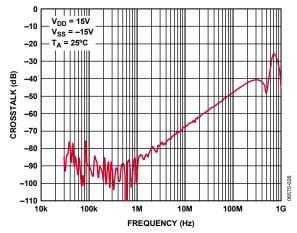


Figure 16. Crosstalk vs. Frequency

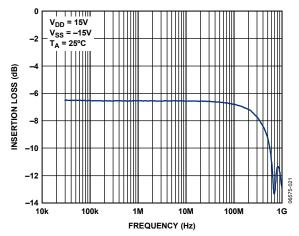


Figure 17. On Response vs. Frequency

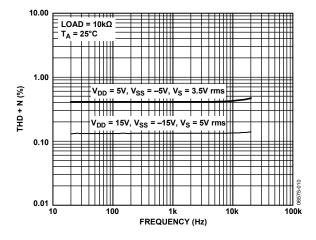


Figure 18. THD + N vs. Frequency

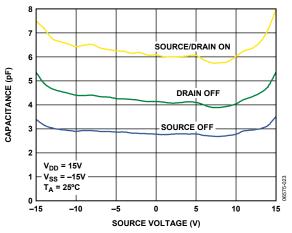


Figure 19. Capacitance vs. Source Voltage for Dual Supply

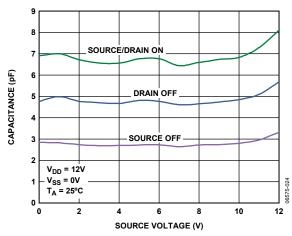


Figure 20. Capacitance vs. Source Voltage for Single Supply

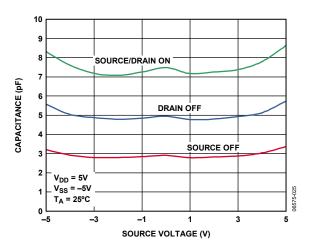


Figure 21. Capacitance vs. Source Voltage for Dual Supply

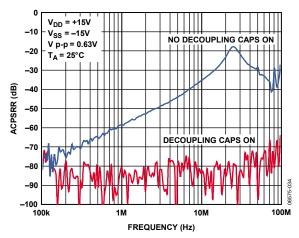


Figure 22. ACPSRR vs. Frequency

TEST CIRCUITS

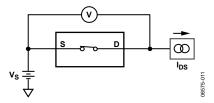


Figure 23. On Resistance

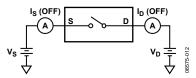


Figure 24. Off Leakage

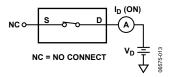
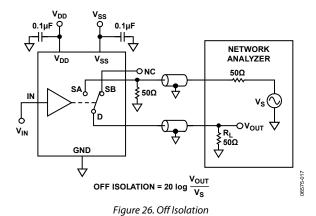


Figure 25. On Leakage



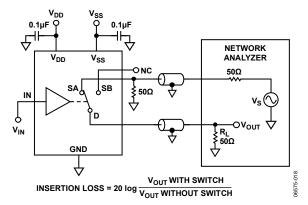


Figure 27. Channel-to-Channel Crosstalk

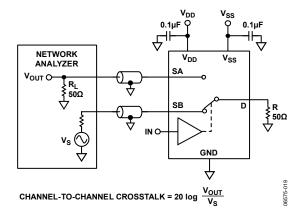


Figure 28. Bandwidth

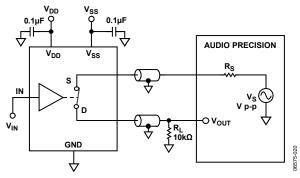


Figure 29. THD + Noise

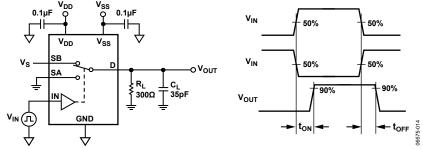


Figure 30. Switching Times

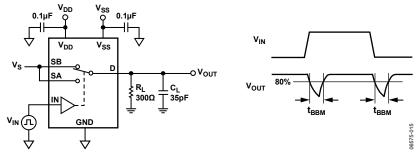


Figure 31. Break-Before-Make Time Delay

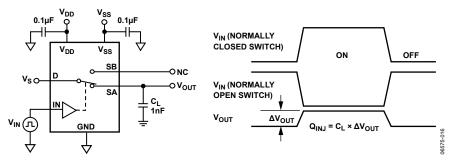


Figure 32. Charge Injection

TERMINOLOGY

 I_{DD}

The positive supply current.

 I_{ss}

The negative supply current.

 $V_D(V_s)$

The analog voltage on Terminal D and Terminal S.

R_{ON}

The ohmic resistance between Terminal D and Terminal S.

R_{FLAT(ON)}

Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal range.

Is (Off)

The source leakage current with the switch off.

I_D (Off)

The drain leakage current with the switch off.

 I_D , I_S (On)

The channel leakage current with the switch on.

 \mathbf{V}_{INI}

The maximum input voltage for Logic 0.

 V_{INH}

The minimum input voltage for Logic 1.

IINL (IINH)

The input current of the digital input.

Cs (Off)

The off switch source capacitance, measured with reference to ground.

C_D (Off)

The off switch drain capacitance, measured with reference to ground.

 C_D , C_S (On)

The on switch capacitance, measured with reference to ground.

 C_{IN}

The digital input capacitance.

ton (EN)

Delay time between the 50% and 90% points of the digital input and switch on condition.

toff (EN)

Delay time between the 50% and 90% points of the digital input and switch off condition.

ttransition

Delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

Тввм

Off time measured between the 80% point of both switches when switching from one address state to another.

Charge Injection

A measure of the glitch impulse transferred from the digital input to the analog output during switching.

Off Isolation

A measure of unwanted signal coupling through an off switch.

Crosstalk

A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.

Bandwidth

The frequency at which the output is attenuated by 3 dB.

On Response

The frequency response of the on switch.

Insertion Loss

The loss due to the on resistance of the switch.

Total Harmonic Distortion (THD + N)

The ratio of the harmonic amplitude plus noise of the signal to the fundamental.

AC Power Supply Rejection Ratio (ACPSRR)

Measures the ability of a part to avoid coupling noise and spurious signals that appear on the supply voltage pin to the output of the switch. The dc voltage on the device is modulated by a sine wave of 0.62 V p-p. The ratio of the amplitude of signal on the output to the amplitude of the modulation is the ACPSRR.

OUTLINE DIMENSIONS

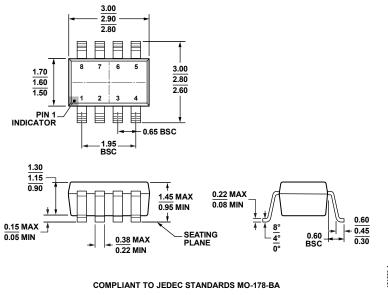


Figure 33. 8-Lead Lead Small Outline Transistor Package [SOT-23] (RJ-8) Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
ADG1219BRJZ-R2 ¹	−40°C to +125°C	8-Lead Lead Small Outline Transistor Package [SOT-23]	RJ-8	S24
ADG1219BRJZ-REEL7 ¹	−40°C to +125°C	8-Lead Lead Small Outline Transistor Package [SOT-23]	RJ-8	S24

 $^{^{1}}$ Z = RoHS Compliant Part.

NOTES